olivary stratum on the same side and the arcuate fibres and nuclei of Goll and Burdach of the opposite side,—and an ascending degeneration, which can be followed only as far as the anterior corpora quadrigemina and the inferior part of the optic thalamus, but leaves completely intact the fibres passing through the lenticular nucleus, the nucleus of Luys, the globus pallidus and the commissure of Meynert.

3. In four cases lesion of the region of the optic thalamus is followed by a slight atrophy of the mesial fillet, diminishing downwards as we approach the nuclei of Goll and Burdach. This atrophy belongs in the category of "atrophic cellulipète," described by Forel. There is no reason to believe that the cells of the fibres that atrophy apparently downward must be located in the thalami; at any rate, most of the fibres of the fillet come from the cells of the nuclei of Goll and Burdach.

4. Among the nineteen cases of lesion of the motor and parietal area there is especially one which seems very conclusive. The whole external aspect of the left hemisphere and the orbital surface of the frontal lobe were softened; the central ganglia were, however, not involved. The patient had had right hemiphlegia with total aphasia for eleven years. The secondary degeneration involved: the radiations of the thalamus, of the internal and external geniculate body, the fibres to the pons and medulla, the pyramidal tract, etc., a total degeneration of the internal capsule, of the crus cerebri, the locus niger and part of the red nucleus. With all this, the fillet was intact and also the aura lenticularis. A drawing in Dejerine's *Anatomie des centres nerveux*, Vol. I, p. 180, gives the whole plan of the sensory pathways as it follows from his cases.

Dr. Jakob's paper appeared before Dejerine's and adds another case in favor of Von Monakow's view; his remark, that the central sensory nerve cell might be located in the globus pallidus, cannot be upheld by facts, and does not invalidate the view of Von Monakow and Dejerine, which may be summed up as follows:

1. The periphery sensory element is a spinal ganglion cell.
2. The first central sensory nerve cell is a cell of the nuclei of Goll and Burdach, which helps in forming the fillet of the opposite side, and ends in the optic thalamus.
3. The higher central sensory nerve cell is situated in the optic thalamus and sends its process to the cortex of the parietal lobe.

ADOLPH MEYER.

Beiträge zur Kenntniss des Reichtums der Grosshirnrinde des Menschen an markhaltigen Nervenfasern. THEODOR KAES. Archiv für Psychiatrie, XXV, 695-758 Tafl. XIII, XIV, Berlin, 1893.

Ueber den Markfasergehalt der Grosshirnrinde eines 1 1-4 jährigen männlichen Kindes. THEODOR KAES. Jahrbücher der Hamburg Staatskrankenanstalten, IV, 1893-94. Hamburg und Leipzig, Leopold Voss, 1896.

Ueber Grosshirnrindenmasse und über Anordnung der Markfasersysteme in der Rinde des Menschen, zugleich ein Beitrag zur Frage: Unterscheidet sich die Rinde des Kulturmenschen von den niederen Racen in Bezug auf Kaliber, Reichthum und Anordnung der markhaltigen Nervernfasern? THEDOR KAES. Wiener Med. Wochenschr., 1895, No. 41 and 42.

Every attempt to discover the physical basis of intelligence in the gross characters of the brain, its size, weight, form or convolu-

tion, has led to no definite result. If such a basis is to be discovered, it must be sought in the minute structures of the cortex itself, and of all the cortical elements, possibly none could serve the purposes of an index so well as the medullated fibre plexuses chosen by our author. We may see the reason for this selection in the fact that as nerve fibres become functional, they become medullated, hence medullation may be taken as a fair measure of functional nerve paths, afferent, efferent, and associational, within the gray matter.

The methods employed are given in the first paper. The brain is partially hardened in Müller's fluid, then cut into twelve transverse slices of equal thickness; the hardening is completed in Müller's fluid and alcohol; a number of samples are taken from each slice, sections cut and stained by Wolter's (a modification of Weigert's) method. About 100 regions are examined in each hemisphere.

The first paper deals with the results obtained from the study of two brains, respectively eighteen and thirty-eight years old, from males dying of phthisis, this latter disease being selected because mental faculties are so well retained to the last. His gross result leads Kaes to differ decidedly from views usually accepted as to time of medullation of the cortex. Edinger states that differences of medullation cannot be followed after the third year; Obersteiner, that medullation seems to be about complete by the seventh year, while Kaes considers his results to prove that between the eighteenth and thirty-eighth year the medullation of the cortex has made enormous strides — "*noch gewaltig fortschreitet.*" It does not seem to occur to him that these differences may be accounted for by a great number of factors peculiar to the individuals other than age.

The study of fibre content of the infant's brain, as well as of all those that follow, was made by the same method, and is of especial value as giving us the different layers and plexuses in the process of forming. The brain weighed 1030 grammes, a little more than average for a child between one and two years, as usually stated. The author first discusses macroscopic methods of investigation. The color of the cortex will not serve, as in adults, where colors range from yellow through yellowish gray to gray, because the child's cortex is almost uniformly yellow. The color of the medullary core of the convolutions gives some insight into unfolding of a child's brain. In adult brains this stains black and deep-black, while in the child the tints vary from bright-gray, gray, dark, to black and deep-black. The relative percentages of these tints show that medullation (Projection+Meynert's Fibræ Propriæ) in the right hemisphere has proceeded farther than in the left. Comparison of mass of whole cortex and of different layers for the convex, median and under surfaces of a child's brain with that of eighteen-year and thirty-eight-year brains shows that the thickness of the cortex is greater in the child, which is due to the fact that the medullary substance is still growing up into the gray matter. The cortex in the sulci develops more rapidly than at the sides and top of convolutions. Thickness of cortex is greatest, however, on top of the convolutions and least in the sulci. In average breadth of projection bundle, medullary axis of the convolution, the child falls short of the adult by a small fraction of a millimeter. For details of development of different cortical layers, the original must be consulted. In all respects, the right hemisphere is better developed than the left. In this respect, the right convex surface leads, the occipital convolutions coming first, the central ranking next. Results of investigation of fibre content of different layers cannot

be briefly stated. The author considers, however, that the projection fibres form a fixed point, about which the whole central association system is built up. The Fibræ Propriæ antedate all other fibres in medullation and are prominent in regions otherwise poorly developed. In conclusion: The right hemisphere is more advanced in fibre development than the left, while in the adult the opposite is generally true. Right-handedness and the development of speech centre of the left hemisphere are given as reasons for the ultimate left-brainedness of adults. The right occipital region remains better developed because the bilateral use of eyes has not discriminated against it. Regions of the child's brain richest in fibres are the central, especially paracentral, with the occipital next in order; while the region poorest in fibres is the anterior part of the under surface near the insular convolutions. The report, besides charts giving fibre distribution in the cortex, contains several drawings of parts examined.

Too much importance seems to be given to the right-brainedness of the child. May not the case be exceptional, a tendency to left-handedness accounting for this variation? The reasons given for later prepotency of the left hemisphere, speech and right-handedness, seemed almost question begging, for we should naturally suppose that both of these must be determined by superior development of the left hemisphere.

In the last paper some inter-racial comparisons are made, the basis of which is the following series: The brains of eight male Germans, aged respectively 1¼, 18, 38, 41, 42, 45 (two) and 53 years, and one Hindoo and one Chinese, both male and aged about 40. Measurements of cortex, medullary substance and of each fibre plexus in the cortex are carried out with great precision and described in detail for each location. It is shown that the thickness of the cortex is greatest in a child. Decrease in thickness shows on the convexity until the eighteenth year, and on the other two surfaces until the thirty-eighth year. Later, there is an increase, which culminates about the forty-fifth year. At a given age the meagrely fibred parts of the cortex are thicker, while those regions rich in fibres are thinner. Of the dimensions of particular parts of the cortex, the author gives chief attention to the two groups of superradial and interradial fibres, respectively. While the interradial plexus in all three surfaces of the child's brain has reached almost the greatest thickness, which appears stable from thirty-eight years onward, the superradial system shows constant growth from eighteen to forty-five years, but does not continue beyond fifty. After discussing the relative distribution of the fibres in the two hemispheres, the author reaches the general conclusion that the cortical development from childhood to extreme age, for the whole cortical thickness as well as for the medullary substance and for the particular layers of the cortex, may be determined with great precision. As for the medullary substance, the greatest thickness corresponds to the most powerful fibre development. For the association systems of the cortex, the reverse is true. The stronger association development is connected with the thinner cortex. In adults the left convexity is thinner, but is richest in fibre development. The fact that the right is most strongly developed in the child accounts for the brief period of facility in use of the left hand, which, in the author's opinion, immediately precedes the prepotency of the right. Comparison with the Hindoo brain (average of Germans does not include the child's brain) shows that the thickness of the medullary core of the convolutions is less than in the Germans. This is true only of the under surface in the Chinese

brain. In general thickness of cortex, the Germans and Chinese are more nearly alike, while the Hindoo in both hemispheres approaches more nearly to the dimensions in the child. In superradial fibres, the Asiatics are behind the German average. Interradial fibres are about the same, or perhaps somewhat more developed in the Hindoo. The following seems to be the rule: The less a part of the cortex is developed in regard to fibre content, the more nearly the same are the averages of German and Asiatic. Smell and taste centres in *Gyrus Fornicatus* show less fibre development in the Germans than in the Asiatics. The chief difference between the Germans and Asiatics is perhaps as follows: The Chinese and Hindoos show luxuriant growth of interradial fibres, while in the Germans the more vigorous growth appears in the superradial fibres.

We are indebted to the author for a vast amount of work very carefully done; but from individual differences, which appear in his tables, we should think that general conclusions as to brain growth at different ages, and characteristic development of different races had better be deferred until a much larger number of brains have been examined.

E. H. LINDLEY.

The Sense Organs of Lumbricus Agricola (Hoffm). FANNY E. LANGDON. *Journal of Morphology*, XI, 194-232, Pls. XX, XIII and XIV, 2 Figs. in text. Boston, 1895.

In the total absence of any definite type of sense-organ, the sensitiveness of the earthworm to such various stimuli as light, taste, smell and touch has remained a standing puzzle. The older writers, beginning with Leydig and Schulze, and coming down to Mojsisovics and Ude in more recent years, did, it is true, give some ground of hope that the problem might find a solution in the discovery of a definite organ. Their authority, however, was about balanced by other investigators, who failed to find any trace of either structure or grouping indicative of special sensory functions among the epidermal cells. The matter seemed closed, when both Retzius and Lenhossék, employing most approved methods, declared against the presence of definite sense-organs. In the face of these authorities, however, our author is able to clear up the subject in a way that can leave no room for doubt.

The sense-organ of Lumbricus is shown to consist of a number of ganglion cells, arranged in oval groups very much like taste buds. From the distal end of each cell a sensory hair perforates the cuticle to the exterior, while from its central end arises a nerve fibre which passes with the sensory nerve trunk into the ventral ganglion of the same side and segment. The size of the organs, 100 by 60 μ, as well as their number, averaging 1,000 to each segment, make it doubly remarkable that they have been overlooked so long. Plate XIV presents us with camera drawings of the sensory spots as seen on the cuticle of a specimen for characteristic metameres. From this it appears that the organs are in general scattered irregularly over the surface, somewhat more numerous on the cephalic than caudal half of the segment, and more numerous near the extremities than in the middle of the body. No differentiation of organs for different senses has been made out.

The paper is compactly and clearly written and well illustrated, and in every respect merits high rank in the literature of comparative sense-organs.

C. F. H.